

REMARKS**SPECIFICATION**

The specification has been amended to correct certain inadvertent typographical errors. No new matter has been added by the amendments to the specification.

REJECTION OF THE CLAIMS UNDER 35 U.S.C. § 102

Claims 1-14 were rejected under 35 U.S.C. § 102(b) as being anticipated by previously cited Tohyama et al U.S. Patent No. 5,642,371.

For the reasons set forth hereafter, it is submitted that the claims are patentable over Tohyama et al.

PATENTABILITY OF THE CLAIMS

Applicants' claimed invention is directed to a module for optical communication. A module for optical communication is shown in Fig. 5, for example. The module has a modulator integrated semiconductor laser including a semiconductor laser active region and an optical modulation region. The semiconductor laser active region has a multiple quantum well structure having quaternary mixed crystal layers selected from the group consisting of quaternary compounds of In, Ga, Al and As or quaternary mixed compounds of In, Ga, N and As. As a result of using the specified quaternary mixed compounds, the

temperature of the semiconductor laser active region or the temperature of a component in thermal contact with the semiconductor laser active region for holding the temperature of the semiconductor laser active region can be set to 35°C or higher during operation of the semiconductor laser and the optical modulator. That is, by using the specified quaternary compound semiconductor material containing Al or N, it is possible to ensure adequate optical power at a high temperature, which enables low power consumption of a cooling element controlling the temperature of the modulator integrated laser. (room)

A significant feature of the present invention is that the active region has a multiple-quantum well structure having at least two quaternary mixed crystal layers selected from the group consisting of quaternary mixed compounds of In, Ga, Al, and As and quaternary mixed compounds of In, Ga, N, and As, for example, InGaAlAs/InGaAlAs. See, for example, page 16, lines 3-5, page 22, line 4 (embodiment 1), page 23, line 17 (the compositional ratio of embodiment 1), page 25, lines 9-10 (embodiment 2), and page 27, lines 14-16 (embodiment 3) of the specification.

On the other hand, Tohyama et al does not show such quaternary mixed compounds of In, Ga, Al, and As for such a multiple-quantum well structure as the Examiner has stated.

The multiple-quantum well structure of the present invention has at least two quaternary mixed crystal layers, InGaAlAs/InGaAlAs.

The Examiner states that Tohyama et al discloses "quaternary mixed compound of In, Ga, Al, and As..." on page 3, lines 4-5 of the Action and refers to Figs. 27A to 27C, column 24, lines 56-57 and column 25, lines 1-39 of the patent. However, the mixed compound material of Tohyama et al is not used for a multiple-quantum well structure. The mixed compound material of Tohyama et al serves as a supporting layer. See column 25, lines 33-36 of Tohyama, which states, for example, "a semiconductor mixed crystal layer may be formed in the mesa portion as a heat flow delay layer, which may then be integrally bonded on a high thermal-conductivity substrate...". Accordingly, the disclosure of a semiconductor mixed crystal layer in Tohyama et al does not anticipate the present invention.

It is further significant that there is a structural difference between the present invention and Tohyama et al. The modulator of the present invention relates to a modulator having a function of power control. Tohyama et al, however, is directed to providing a semiconductor laser device capable of changing an oscillation wavelength. Therefore, Tohyama et al has a plurality of current injection regions. Because the hot carriers injected into the active layer are converted into

heat immediately, the temperature of the active layer rises immediately after the start of current injection, and this makes the response speed of the thermal effects faster. See column 9, lines 5-16 of Tohyama et al.

The Examiner also states that Tohyama et al teaches that "a semiconductor laser active region or temperature of a component in thermal contact with the semiconductor laser active region for holding the temperature of the semiconductor laser active region is set to 35°C or higher during operation of the semiconductor laser active region and the optical modulator region (see Fig. 28)" on page 3 of the Action. However, Fig. 28 shows merely at most 33°C as clearly shown on the copy of Fig. 28 attached as an exhibit. Independent claims 1, 5 and 11 all call for the temperature be set to 35°C or higher. Indeed, in the first Office Action of October 7, 2002 the Examiner specially acknowledged at pages 3 and 4 that Tohyama et al did not disclose that the temperature of the semiconductor laser active region is set to 35°C or higher during operation of the semiconductor laser active region and the optical modulation region.

Applicants further call the Examiner's attention to the fact that an interview was conducted with the Examiner and the Examiner's supervisor, Mr. Paul Ip, on January 16, 2003. In the interview it was suggested by the Examiners that the claims be amended to clearly define the invention by reference

to Figs. 1, 2 (Fig. 2 is a comparison figure), 3, 4 and 8 of the present application. Accordingly, in the amendment filed February 7, 2003 Applicants amended the independent claims 1, 5 and 11 to clearly define the elements of the module being claimed. Specifically, Applicants amended the independent claims by adding the following recitation:

"...in which a band offset of a conduction band is larger than a band offset of a valence electron band, said at least two quaternary mixed crystal layers being...

As explained in the specification, the optical power of a modulator integrated laser typically decrease as its temperature increases because of an overflow of injection current at a high temperature. See page 16, lines 8-10 of the specification. This is not a problem, however, with the modulator integrated laser of the present invention because the claimed multiple quantum well structure having the specified quaternary compound semiconductor material containing Al or N has a band offset value of the conduction band that is larger than the valence band offset value, as explained at page 10, lines 12-21 of the specification with reference to Fig. 3. Accordingly, in the amendment filed February 7, 2003, Applicants amended the independent claims to include the limitation quoted above, which is not shown or suggested by Tohyama et al or any other art of record.

On pages 2 and 3 of the Action the Examiner stated that Tohyama et al disclosed the following:

"...said semiconductor laser active region having a multiple quantum well structure (see Figs. 16-18, Character 55 and 53) having at least two quaternary mixed crystal layers in which a band offset of conduction band is larger than a band offset of a valence electron band, said at least two quaternary mixed crystal layers being selected from the groups consisting of quaternary mixed compound of In, Ga, Al and As and a quaternary mixed compound of Un, Ga, N and As (see Figs. 27A to 27C, Column 24, lines 56-57, Column 25, lines 1-39),..."

Applicants, however, believe the Examiner has misinterpreted teachings of Tohyama et al to the extent that the Examiner states that Tohyama et al discloses "a multiple quantum well structure... having at least two quaternary mixed crystal layers in which a band offset of conduction band is larger than a band offset of a valence electron band,...". Applicants can find no teaching of the limitation "... in which a band offset of a conduction band is larger than a band offset of a valence electron band, said at least two quaternary mixed crystal layers being..." which was added by the February 7, 2003 amendment and which limitation remains in each of the independent claims 1, 5 and 11. Applicants therefor submit that the claims are patentable for this reason as well as for the other reasons discussed above.

In view of the foregoing amendments and remarks, Applicants contend that this application is in condition for allowance. Accordingly, reconsideration and reexamination are respectfully requested.

Respectfully submitted,



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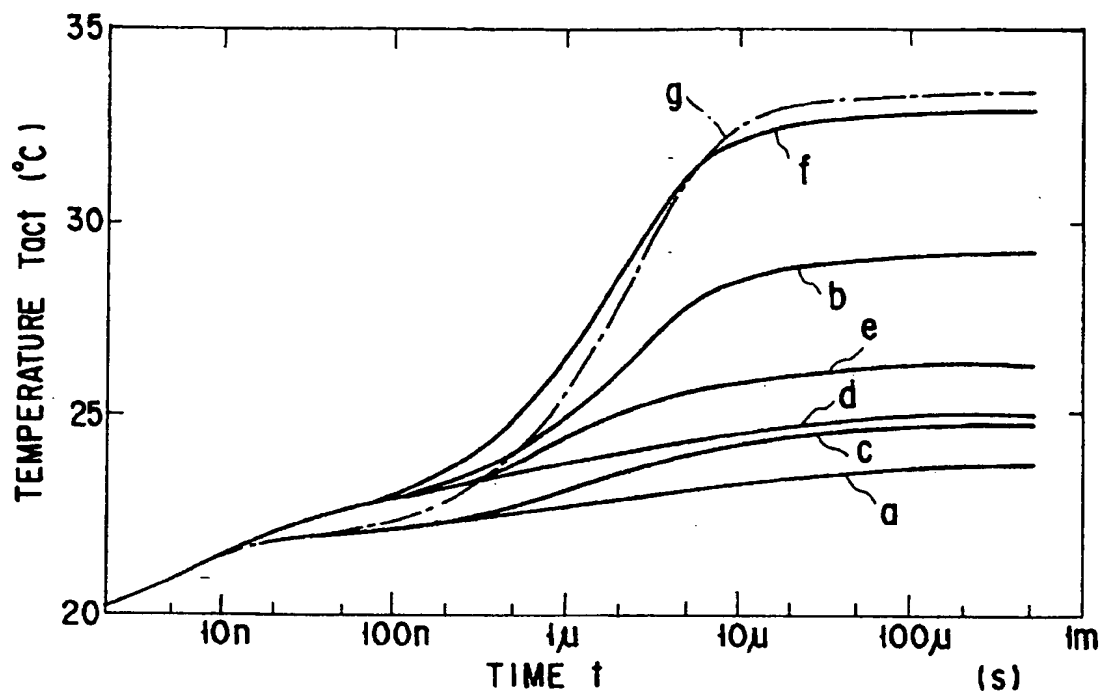


FIG. 28

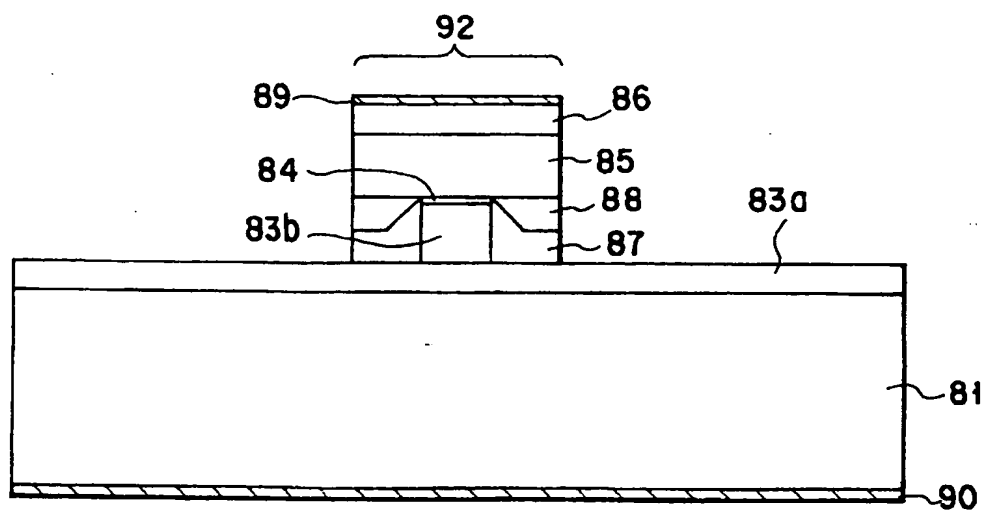


FIG. 29